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Five-Year Review Report Naval Air Station Brunswick, Maine



Prepared by

Department of the Navy
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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March 31, 2000

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Re: *Five-Year Review Report, Naval Air Station, Brunswick, Maine*

Dear Mr. Coccoli:

Thank you for the opportunity to review *Five-Year Review Report for Naval Air Station, Brunswick, Maine* dated March 2000. Upon review, the EPA concurs with the finding that all remedies as implemented, or in the process of being implemented, by the Navy are protective of human health and the environment.

The Report includes reviews for sites 1, 2, 3, 4, 9, 11, 13 and the Eastern Plume and is consistent with EPA's *Five Year Review Guidance, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-02* (May 1991 and *Supplemental Five-Year Review Guidance, (OSWER) Directive 9355-02A* (August 1994)). The selection of a Type IA review is also consistent with the above guidance. For those sites which that are still in the investigative or remedy selection phases, EPA is pleased that the Navy has reiterated it's commitment to continuing the CERCLA cleanup process to a successful conclusion. Access to these sites is restricted to minimize potential threats to human health.

EPA fully concurs with the findings and recommendations for further action in the review. Once these recommendations are carried out, they will ensure full protectiveness of the remedies implemented. Key recommended actions EPA specifically endorses are:

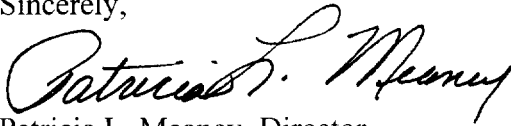
- Adding groundwater institutional controls to the OU5 ROD and documenting them in the NAS Brunswick Base Instructions for OU1, OU5, OU6 and OU7.
- Verification of the southern boundary of the eastern plume (OU5).

Though not explicitly required for remedy protectiveness, we also support the Navy's recommendations to optimize the eastern plume remedy as they should reduce the time required to meet the ROD objectives.

As indicated in EPA's letter of April 2, 1999, this five-year review was triggered by the Sites 1

and 3 (OU1) Remedial Action start of December 6, 1994 and was therefore due December 6, 1999. Consistent with Section 121(c) of CERCLA and *(OSWER) Directive 9355-02A*, the next statutory required five-year review must be finalized prior to December 6, 2004.

Sincerely,

A handwritten signature in black ink, reading "Patricia L. Meaney". The signature is fluid and cursive, with the first name "Patricia" being more prominent and the last name "Meaney" following in a similar style.

Patricia L. Meaney, Director

Office of Site Remediation and Restoration

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1. INTRODUCTION

A statutory five-year review has been conducted by the U.S. Department of the Navy (Navy) pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act; Section 300.400(f)(4)(ii) of the National Oil and Hazardous Substances Contingency Plan; Executive Order 12580; and U.S. Environmental Protection Agency (U.S. EPA) Office of Solid Waste and Emergency Response Directive 9355.7-02 (23 May 1991), Office of Solid Waste and Emergency Response Directive 9355.7-02A (26 July 1994), and Office of Solid Waste and Emergency Response Directive 9355.7-03A (21 December 1995). The purpose of this five-year review is to ensure that the remedial actions selected for the Naval Air Station (NAS) Brunswick National Priorities List sites remain protective of human health and the environment, and are functioning as designed.

This review is a Type 1a review, which is applicable at sites where response is ongoing. According to U.S. EPA guidance, a Type 1a review consists of a document review (including Record of Decision [ROD] declarations and monitoring information) and preparation of a report that provides a discussion of remedial objectives, areas of non-compliance with those objectives, recommendations for improvements, and a statement of whether the remedy/remedies remain protective. This report will become part of the Site File (Administrative Record).

The Federal Facilities Agreement for NAS Brunswick, Maine, dated 19 October 1990, also requires a five-year review. The trigger date for this statutory review was determined by the remedial action on site construction of the first operable unit giving rise to a five-year review. For NAS Brunswick, the trigger site was the remedial action onsite construction date of the Sites 1 and 3 Landfill. The guidance further states that sites subject to five-year reviews with multiple remedies or operable units should conduct a five-year review for the entire site and all operable units.

1.1 ORGANIZATION OF REPORT

This document presents the first five-year review of NAS Brunswick. The following operable units have ongoing remedial actions as of the date of the five-year review documented in this report:

- **Chapter 2**—Site 1 Orion Street Landfill – North and Site 3 Hazardous Waste Burial Area.
- **Chapter 3**—Site 2 Orion Street Landfill – South.
- **Chapter 4**—Site 9 Neptune Drive Disposal Area.
- **Chapter 5**—Eastern Plume Operable Unit (Site 4 – Acid/Caustic Pit, Site 11 – Fire Training Area, and Site 13 – Defense Reuse and Marketing Office Area).
- **Chapter 6**—References.

- **Appendix A**—Response to comments on the draft Five-Year Review Report received from the U.S. Environmental Protection Agency and the Maine Department of Environmental Protection.

Table 1 provides a summary of the status of the remaining active sites in the NAS Brunswick Installation Restoration Program. These sites will be addressed in the next five-year review. The next five-year review shall be completed by 6 December 2004.

Table 1 is a summary of active sites not included in the first five-year review. Table 2 is a summary of inactive sites that will not be addressed in the five-year reviews.

1.2 NEXT FIVE-YEAR REVIEW

The next five-year review shall be completed by 6 December 2004.

2. SITE 1 ORION STREET LANDFILL – NORTH AND SITE 3 HAZARDOUS WASTE BURIAL AREA

2.1 SITE DESCRIPTION

Sites 1 and 3 are closed hazardous waste landfills within the same operable unit and are located within a restricted portion of NAS Brunswick (Figures 1 and 2). Reportedly, these landfills received a variety of waste material, such as garbage, food, oils, solvents, pesticides, petroleum products, paint, aircraft and automobile parts, and various chemicals. Field activities did not indicate a clear boundary between these sites although they were regarded as separate disposal areas. Compounds/analytes that were detected above background concentrations during previous investigations include: polycyclic aromatic hydrocarbons and pesticides in soil; volatile organic compounds (VOCs) and inorganics in ground water; VOCs, inorganics, and semivolatile organic compounds (SVOCs) in leachate; VOCs, SVOCs, polycyclic aromatic hydrocarbons, and inorganics in stream sediment; and inorganics in surface water.

2.1.1 Significant Events

- 1992 ROD was signed (U.S. Department of the Navy 1992a).
- 1994 Remedial Action started.
- 1995 Long-Term Monitoring initiated.
- 1995 Remedial Action Closure Report.
- 1998 Cessation of Pumping from Landfill Extraction Wells—Operation of the landfill extraction wells had been intermittent since the water level fell below the extraction well screen.
- 1999 Slurry Wall Demonstration Completed—U.S. Department of Energy, Federal Energy Technology Center through Science and Engineering Associates, Inc. requested the landfill cap slurry wall be used to demonstrate a vadose zone barrier monitoring system. Only a portion of the slurry wall was used for the demonstration.
- 1999 Completion of Erosion Repairs—The 1998 visual inspection of the landfill cap noted erosion of the protective cap, although a small portion of the underlying landfill liner was exposed but undamaged. Corrective measures to correct the landfill cap erosion were completed in 1999.
- 1999 NAS Brunswick Restriction on Excavation Activities Instruction (NASBINST 5090.1A).
- 2000 Final Long-Term Monitoring Plan (EA 2000a).

2.2 DISCUSSION OF REMEDIAL OBJECTIVES

In the 1992 ROD, the remedial objectives were set as follows:

- Reduce the generation and mitigation of contaminated ground water.
- Reduce the potential risk associated with ingestion of contaminated ground water.
- Minimize future negative impacts to Mere Brook and the sediment in the leachate seeps resulting from the discharge of contaminated ground water and leachate.
- Reduce the concentrations of metals (iron and zinc) discharging to Mere Brook.

To accomplish these objectives, the following components were implemented:

- A slurry wall was placed around the landfill (with the exception of the Weapons Compound Area) to divert clean ground-water flow around the site, preventing contact with the waste material. The slurry wall is sealed into the underlying silty clay and, therefore, minimal volumes of water flow beneath or through the wall.
- A low permeability cap was placed over the landfill area and slurry wall to reduce the amount of rainfall infiltration, thereby reducing leachate production.
- A ground-water extraction system was installed to remove contaminated ground water trapped beneath the cap and within the slurry wall system. Capturing this contaminated water prevented it from discharging to Mere Brook. These extraction wells facilitated the collection of the ground water remaining within the limits of the slurry wall after the construction of the landfill cap and reduced the time required to lower ground-water levels below the waste.
- This alternative requires the implementation of institutional controls and land use restrictions to prevent future invasive reuse of the landfills or underlying ground water.

2.3 AREAS OF NON-COMPLIANCE

Any substantial aspect of the remedial action that fails to conform to remedial objectives would be considered an area of non-compliance. Based on the information evaluated as part of the Type 1a five-year review, all areas currently comply with the ROD remedial objectives.

A comparison of water elevation data collected prior to emplacement of the slurry wall in March 1995 and subsequent long-term monitoring gauging data indicates that water elevations have decreased significantly within the landfill. Water surface elevations within the landfill have stabilized and have not shown significant rebound after cessation of pumping the landfill extraction wells in November 1997 (EA 2000b).

Monitoring wells located outside of the Sites 1 and 3 landfill have detected inorganic elements (arsenic, manganese, and chromium) in the ground water exceeding the Maximum Contaminant Level (MCL) and/or the Maximum Exposure Guideline (MEG). However, most of the detected concentrations of these inorganics are exhibiting a general decreasing trend.

VOCs have been detected at increasing concentrations in the ground water at monitoring wells within the landfill. No VOCs have been detected at concentrations above MCLs or MEGs downgradient and outside the landfill, except at SEEP-04.

Potentiometric heads in the shallow and deep monitoring wells downgradient of the landfill in the vicinity of the Weapons Area Compound and Mere Brook show a trough in water elevations. The interpreted 21-ft contour potentiometric surface lines in the deep interval downgradient of the landfill are deflected towards the southern end of the Sites 1 and 3 landfill. This is attributed to the presence of the low permeability cap and previous ground-water extraction activity, in addition to the slurry wall at the Sites 1 and 3 landfill have acted to limit infiltration and ground-water movement in the capped area. The presence of these remedial structures has resulted in an area of lower head downgradient of Sites 1 and 3 (EA 2000b).

Ground water is below the known bottom elevation of waste material at monitored locations within the Sites 1 and 3 landfill, with the exception of MW-234R (EA 2000b). At this location, less than 1.0 ft of waste material was saturated in 1998. Based on the comparison to waste and water elevations, the landfill cap and slurry wall are successfully minimizing the saturation of waste within the Sites 1 and 3 landfill (EA 2000b).

Iron and zinc have been monitored in seep samples as part of the Long-Term Monitoring Program. The ROD reported maximums (maximum detected concentration) of 2,510,000 µg/kg and 2,770 µg/kg for iron and zinc, respectively. Since the monitoring began, iron has only exceeded these maximums in Monitoring Events 8, 10, and 11. Exceedance of the maximum for zinc has not been reported in any monitoring event report to date.

The operable unit remains within the restricted area of the base and, as such, the institutional controls remain effective. However, ground-water institutional controls will be added to Operating Instruction NASBINST 5090.1A, "Restriction on Excavation Activities" in the next annual revision.

2.4 RECOMMENDATIONS

- No further response actions are required at this time.
- An institutional control to restrict ground-water use will be added in the next revision of Operating Instruction NASBINST 5090.1A, "Restriction on Excavation Activities." The next revision of NASBINST 5090.1A is scheduled for September 2000. Ground-water institutional controls are not documented in the ROD, and need to be added to the ROD.

- Ongoing operation and maintenance activities should continue and be summarized in annual reports. Annual reports and event monitoring reports will continue to be submitted to U.S. EPA and Maine Department of Environmental Protection (MEDEP).

2.5 STATEMENT OF PROTECTIVENESS

The purpose of the five-year review is to ensure that the selected remedy remains protective of human health and the environment and is functioning as designed. The source control remedy selected for Sites 1 and 3 Operable Unit has been successfully implemented, and remains protective of human health and the environment as long as the area maintains restricted access. If the area were to become freely accessible, institutional controls would have to be imposed on the site. Long-term operation and maintenance activities are ongoing. Operational activities also include ground-water, surface water, sediment, and landfill gas sampling.

3. SITE 2 ORION STREET LANDFILL – SOUTH

3.1 SITE DESCRIPTION

Site 2 Orion Street Landfill is a closed hazardous waste landfill located south and across Mere Brook from Sites 1 and 3 Landfill within the restricted area in the central portion of NAS Brunswick (Figures 3 and 4). Site 2 was used as the primary landfill for NAS Brunswick from 1945 to 1955, although actual operation may have been less than 10 years because NAS Brunswick was closed from 1946 to 1951. The base was occupied by non-military tenants from 1946 to 1951, and it is not known if the landfill was utilized during that period.

The landfill occupies approximately 2 acres of soil covered land that currently supports a dense stand of conifers. Prior to remedial actions, miscellaneous debris items such as drums, containers, office furniture, and domestic wastes were exposed along the eastern side of the landfill. Other wastes reportedly disposed at the landfill were solvents, paint, oil, toluene, methyl ethyl ketone, and medical supplies. Solid wastes were incinerated (openly burned) at the site and a substantial component of the landfill material could be ash and partially burned materials. The Site 2 Landfill was closed by capping the area with soil and planting pine trees on top of the cap.

Based on the available sample results, environmental contamination at Site 2 was evident in surface waters, stream sediments, ground-water seeps, and surface soils associated with seep locations. During the Remedial Investigation in 1990 (E.C. Jordan 1990), lead was detected in the ground-water samples at concentrations ranging from 80 to 180 µg/L that exceeded the Federal MCL of 5 µg/L. The lead detection in site ground water is consistent with historic use of the site. Ash would have been produced by incineration (open burning) at the landfill, and ash typically contains inorganic constituents that would not be destroyed by burning. The shallow ground water in this area is not used for a potable supply.

No unacceptable risk to human health was identified under the future residential use scenario. A quantitative exposure assessment for ingestion of ground water was not developed for Site 2 since there is no exposure along this pathway. Future use of ground water is not considered likely because this property is under control of the Navy, and the shallow aquifer between Site 2 and Mere Brook is not likely to be used as a drinking water source (U.S. Department of the Navy 1998a).

3.1.1 Significant Events

- 1998 ROD was signed (U.S. Department of the Navy 1998a).
- 1999 Remedial Action – Debris removal and bank stabilization completed.
- 1999 NAS Brunswick Operating Instruction NASBINST 5090.1A, “Restrictions on Excavation Activities.”
- 2000 Final Long-Term Monitoring Plan (EA 2000c).

3.2 DISCUSSION OF REMEDIAL OBJECTIVES

In accordance with the 1998 ROD, remedial objectives were not developed for this site because no risk to human health or the ecological receptors was indicated by the baseline risk assessment. The selected remedy for Site 2 was Minimal Action. Implementation of the Minimal Action Alternative includes the following components:

- Implementation of institutional controls to include maintenance of the existing fence, installation of warning signs, and land use restrictions. Land use restrictions are incorporated in Operating Instruction NASBINST 5090.1A, "Restriction on Excavation Activities."
- Removal of surface debris that was visible in the depression immediately south and east of the landfill.
- Installation of an additional ground-water monitoring well.
- Implementation of an environmental monitoring program that includes collection and analysis of ground-water, seeps, surface water, and sediment samples.
- Five-year site reviews.
- Modifications to the selected remedy, if necessary.

3.3 AREAS OF NON-COMPLIANCE

Although no remedial objectives were established for Site 2, the ROD indicated a long-term monitoring plan would be implemented to confirm the protectiveness of the selected remedy. Data collected during the monitoring program will be evaluated as part of the five-year review cycle.

Long-term monitoring has not commenced since the plan is currently being implemented. Monitoring is expected to start in 2000.

The operable unit remains within the restricted area of the base and, as such, the institutional controls remain effective. However, institutional controls for restriction of use and contact with ground water will be included in the next revision of Operating Instruction NASBINST 5090.1A, "Restriction on Excavation Activities." The next revision of NASBINST 5090.1A is scheduled for September 2000.

3.4 RECOMMENDATIONS

- No additional response actions are required at this time.
- Implement the Long-Term Monitoring Plan and commence monitoring.

- The sampling event reports and annual reports will be submitted to U.S. EPA and MEDEP.
- Based on the annual reports, the Long-Term Monitoring Plan will be refined as needed.
- Amend the Operating Instruction NASBINST 5090.1A "Restriction on Excavation Activities" to include a restriction of use and physical contact with the ground water.

3.5 STATEMENT OF PROTECTIVENESS

The purpose of the five-year review is to ensure that the selected remedy remains protective of human health and the environment and is functioning as designed. Environmental monitoring has not been performed since 1990. A determination for success of Minimal Actions cannot be made at this time because the activities necessary for implementation of the Minimal Action Alternative have not been completed. However, restricted access to the site and restrictions on excavation activities have reduced the potential for human exposure, thereby providing partial protection of human health. Implementation of the recommended sampling actions will provide the data necessary to determine if the environment is protected. Long-term monitoring will be ongoing.

4. SITE 9 NEPTUNE DRIVE DISPOSAL AREA

4.1 SITE DESCRIPTION

The Neptune Drive Disposal Site (Site 9) was the former location of an incinerator and ash landfill/dump area, located north of Neptune Drive (Figures 5 and 6). Hazardous material disposal reportedly occurred south of Neptune Drive at unspecified locations. The site has these areas of concern:

- Vinyl chloride was detected in ground-water samples collected as part of the Long-Term Monitoring Program at several monitoring wells. A septic system east of Building 201 was thought to be a possible source of VOCs in ground water; however, results from an additional source investigation indicate that this area is not a likely source for the vinyl chloride contamination in ground water.
- An incinerator was located at what is currently the northeast corner of Building 220, and an ash landfill/dump area is located in the current area of Buildings 218 and 219. There are no exact data detailing the location or types of wastes handled or disposed at these locations, although wastes may have included solvents that were burned on the ground, paint sludge, and metal shop wastes. Inorganics and semivolatile compounds have been detected in soils and the ground water at this area.
- The unnamed stream and impoundment ponds located near Building 201 receive water from the Site 9 area and the central portion of NAS Brunswick. Surface water impoundment ponds were constructed in 1997 to capture stormwater runoff from airfield pavements, parking lots, and roads in the developed central portion of the base. Construction of the surface water impoundments has flooded the former southern unnamed stream and partially flooded the northern unnamed stream.

4.1.1 Significant Events

- 1994 Interim Record of Decision (U.S. Department of the Navy 1994).
- 1995 Long-Term Monitoring initiated.
- 1999 Final Record of Decision was signed (EA 1999a).
- 1999 Final Long-Term Monitoring Plan (EA 1999b).
- 1999 NAS Brunswick Restriction on Excavation Activities Instruction (NASBINST 5090.1A).

4.2 DISCUSSION OF REMEDIAL OBJECTIVES

The objectives developed in the Final Site 9 ROD are as follows:

- To reduce contaminant concentrations in Site 9 ground water to below Federal MCL and State MEG target cleanup levels.

- To prevent human exposure and ecological exposure (i.e., ingestion, dermal contact) to Site 9 ground water.
- To prevent human exposure and ecological exposure (i.e., ingestion, dermal contact) to the contents of the inactive landfill at Site 9.
- To prevent any migration of the Site 9 ground-water plume offsite or of contaminants from the inactive landfill to ground water and/or surface water.

To accomplish these objectives within a 20-year time period, the following components were implemented:

- **Natural Attenuation**—This remedy will be used to allow degradation of contaminants in the ground water at the site to concentrations sustained at or below Federal MCLs and State MEGs. Ground-water monitoring results showing contaminant concentrations will be compared to these remediation goals, and the selected remedy will be continued until site goals are achieved.
- **Long-Term Monitoring**—Long-term monitoring will be implemented to:
 - Assess variations in the concentrations of contaminants in ground water, leachate surface water, and sediment to determine the effectiveness of natural attenuation.
 - Assess whether ground water downgradient of the ash landfill is impacted by inorganics from the site.
 - Assess whether contamination is migrating offsite.
 - Assess variations in ground-water flow patterns.
 - Monitor structural integrity of the ground-water monitoring wells.
- **Institutional Controls**—Institutional controls will be used to prevent use of and contact with impacted ground water, and to prevent the disturbance of or contact with the contents of the ash landfill without prior written approval from the U.S. EPA and MEDEP. These controls will primarily consist of ground-water and land use restrictions.
- **Five-Year Review**—Data collected from the Long-Term Monitoring Program will be reviewed and recommendations for modifications will be made as part of annual reports and in the five-year reviews.

4.3 AREAS OF NON-COMPLIANCE

Any substantial aspect of the remedial action that fails to conform to remedial objectives would be considered an area of non-compliance. Based on the information evaluated as part of the Type 1a five-year review, all areas currently comply with the ROD remedial objectives.

4.3.1 Natural Attenuation

Vinyl chloride was reported at concentrations greater than the corresponding Federal MCL or State MEG in samples taken from several monitoring wells. Assessed indicators of natural attenuation include vinyl chloride trends in the Long-Term Monitoring Program and the ratio of vinyl chloride to 1,2-dichloroethene with time.

The 1998 Annual Report (EA 1999c) illustrates total VOC and vinyl chloride trends for long-term monitoring data collected between 1995 and 1998 for the 7 monitoring wells that have reported vinyl chloride concentrations in this time period. Regression analyses of vinyl chloride data are presented in the 1998 Annual Report for 1995 through 1998, and also presented separately for 1998 data to illustrate changing trends with time. The table below summarizes the trends as indicated by the least-mean square regressions:

Vinyl Chloride Trends		
Well	1995-1998	1998
MW-NASB-069	Increasing	Increasing
MW-NASB-071	Steady at non-detection	Steady at non-detection
MW-NASB-072	Steady	Decreasing
MW-NASB-074	Decreasing	Steady at non-detection
MW-NASB-075	Decreasing	Steady at non-detection
MW-NASB-076	Increasing	Increasing
MW-NASB-080	Steady	Increasing

Assessment of the vinyl chloride/dichloroethene ratio provides a measure of whether dechlorination is occurring in ground water by noting the changes in concentrations of parent-daughter compounds. A decreasing concentration of total dichloroethene and an increasing concentration of vinyl chloride (a breakdown product of dichloroethene) indicates that the dechlorination process is occurring. The table below summarizes trends in the vinyl chloride to total dichloroethene ratios at Site 9:

Vinyl Chloride to Dichloroethene Ratio	
Well	1995-1998 Trend
MW-NASB-069	Stable
MW-NASB-072	Increasing
MW-NASB-074	Stable
MW-NASB-075	Increasing
MW-NASB-076	Increasing
MW-NASB-080	Increasing

The trends indicate the dechlorination process is occurring and therefore demonstrating that natural attenuation is in progress.

4.3.2 Long-Term Monitoring

In 1994, a Long-Term Monitoring Plan was established for Site 9 (ABB-ES 1994). The LTMP was finalized for Site 9 on 16 August 1999 (EA 1999b). The goals of the final 1999 LTMP are as follows:

- Monitor changes in the plume boundaries and potential migration pathways.
- Monitor effectiveness of the remedial action for the protection of human health and the environment.
- Evaluate whether the inactive landfill contents are impacting ground water.
- Monitor the VOC concentration to evaluate the effectiveness of natural attenuation and determine trends with time.
- Monitor impacts to the environment due to Site 9.

4.3.3 Institutional Controls

Institutional controls at Site 9 consist of ground-water and land use restrictions that apply to the entire Site 9 area east of Orion Road and Avenue F, east of MW-NASB-073, and south of Building 52. However, institutional controls to prohibit ground-water use and physical contact with ground water must be incorporated into the next revision of Operating Instruction NASBINST 5090.1A, "Restriction on Excavation Activities." The next revision of NASBINST 5090.1A is scheduled for September 2000. This program was shown to be effective by NAS Brunswick's recent request for concurrence with the proposed Bachelor Enlisted Quarters Military Construction Project.

4.4 RECOMMENDATIONS

- No additional remedial actions are required at this time; however, if sampling trends indicate sustained increases in vinyl chloride concentrations in ground water, additional field work may be required to better delineate a potential plume of deep-seated vinyl chloride. U.S. EPA and MEDEP will be consulted to establish a specific trigger level for this action.
- Ongoing operation and maintenance activities will continue and will be summarized in annual reports. Annual reports and monitoring event reports will continue to be submitted to U.S. EPA and MEDEP.
- The Long-Term Monitoring Plan will be refined as needed based on the annual reports.
- Amend the Operating Instruction NASBINST 5090.1A "Restriction on Excavation Activities" to include a restriction of use and physical contact with the ground water.

4.5 STATEMENT OF PROTECTIVENESS

The purpose of the five-year review is to ensure that the selected remedy remains protective of human health and the environment and is functioning as designed. The Natural Attenuation and Institutional Control remedy selected for Site 9 has been successfully implemented to date, and remains protective of human health and the environment. Long-term monitoring is ongoing.

5. EASTERN PLUME OPERABLE UNIT

The Eastern Plume Operable Unit consists of the following sites:

- Site 4—Acid/Caustic Pit
- Site 11—Fire Training Area
- Site 13—Defense Reuse and Marketing Office Area.

Figure 7 provides the location of the Eastern Plume Operable Unit.

5.1 SITE DESCRIPTION

Site 4: Acid/Caustic Pit—Under the eastern portion of Building 584, this pit was used from 1969 to 1974 to dispose of acidic and caustic liquid wastes. The wastes were poured into the pit, which was approximately 4 feet square and 3 feet deep. In 1975, Building 584 was constructed on top of the pit.

Site 11: Fire Training Area—This area was used regularly over a 30-year period until it was closed in the Fall of 1990. Waste liquids, including fuels, oils, and degreasing solvents, were used as fuel for the fire training exercises.

Site 13: Defense Reuse and Marketing Office Area—This area consisted of the former locations of three underground storage tanks south of Site 4. One underground storage tank was used for diesel fuel; the other two tanks were reportedly used for storage of waste fuels, oils, and degreasing solvents. All three tanks were removed during the late 1980s.

5.1.1 Soils

In 1998, a ROD was signed for No Further Action for soils at Sites 4, 11, and 13. The decision was based on the Feasibility Study (E.C. Jordan 1992) that concluded the only risk remaining at these sites is from the continuing impacts to ground water from soils at Site 11. Removal actions for metallic debris, drums, and contaminated soils were completed at Site 11 following the Feasibility Study. The metallic debris and drums were disposed off-base, and contaminated soils were used for subgrade fill beneath the Sites 1 and 3 Landfill cover (U.S. Department of the Navy 1998b).

Subsurface soils at Building 584 at Site 4 did not contain detectable quantities of VOCs; however, subsurface soil samples were not collected directly from the suspected pit location due to the presence of Building 584 at that location. Therefore, no soils were removed from this location. If the building is ever removed, further investigations and remedial actions may be required.

During the Remedial Investigation (E.C. Jordan 1990), fuel oil contamination was detected in the soil and was believed to have been related to the diesel fuel oil underground storage tanks at Site 13. The underground storage tanks were removed from the site, but no soils were removed.

Ground-water wells were installed and sampled for VOCs. The ground-water VOC data indicate a decrease in VOC concentrations as the result of the underground storage tank removals.

5.1.2 Ground-Water Operable Unit (Eastern Plume)

The Eastern Plume has been attributed to past solvent disposal practices from Sites 4, 11, and 13. The plume of VOC-impacted ground water extends along the eastern boundary of the base, as shown on Figure 8. The presently mapped southern boundary of the Eastern Plume is located near New Gurnet Road (Figure 9).

As an initiative to determine if the plume was discharging to wetlands area, the U.S. EPA, MEDEP, and the Navy installed vapor diffusion samplers in the Summer of 1999. This action was used to assess the possibility for discharge of the Eastern Plume contaminants to wetland areas of Mere Brook and Merriconeag Stream. Diffusion sampler results showed no Eastern Plume contaminants of concern in the sampled wetland areas.

In 1999, a separate "Remedial Action Operation Optimization Case Study" was accomplished to review the Eastern Plume (Radian 1999). The primary purpose of this case study was to evaluate and assess the ongoing remedial action objectives program and provide recommendations resulting in attainment of site remedial action objectives and closure for optimal life cycle costs. Specific elements evaluated for the Eastern Plume pump and treat system include:

1. Overall site remediation strategy and approach.
2. Best operation and management practices already in place.
3. Extraction system network, including all wells, screen intervals, and piping.
4. Performance of treatment system components, including control systems.
5. Operation, maintenance, and control for the treatment units.
6. Treatment system data collection, analysis, and reporting.
7. Effluent discharge options.
8. Appropriate exit strategy for site closeout, including recommendations for the use of alternative technologies, as appropriate.
9. Total estimated cost avoidance/savings from optimized operations.

5.1.3 Significant Events

- 1992 Interim ROD (U.S. Department of the Navy 1992b) was signed.
- 1995 Remedial Action started.
- 1995 Long-Term Monitoring initiated.

- 1998 Final ROD and Remedial Action (U.S. Department of the Navy 1998b).
- 1999 Remedial Action Operation Optimization Case Study (Radian 1999).
- 1999 Two-Day Technical Workshop on Outstanding Regulator Concerns.
- 2000 Final Long-Term Monitoring Plan (EA 2000a).

5.2 DISCUSSION OF REMEDIAL OBJECTIVES

In the 1998 ROD, the remedial objectives were set as follows:

- Minimize further migration of the Eastern Plume.
- Minimize any future negative impact to surface water resulting from discharge of contaminated ground water.
- Reduce the potential risk associated with ingestion of contaminated ground water to acceptable levels.
- Restore the aquifer.

To accomplish these objectives within a 17- to 72-year timeframe, the following components were implemented:

- **Ground-Water Extraction and Treatment**—Continuance of the existing extraction system. In 1992, an Interim ROD was signed for extraction and treatment of the contaminated ground water. The system, operating since May 1995, provides pretreatment to remove turbidity and inorganics, ultraviolet-oxidation to destroy VOCs, discharge of treated water to the local publicly-owned treatment works, and periodic disposal of filter press sludge from the inorganics treatment process. An additional extraction well (EW-2A) was added to the extraction system in July 1998. EW-2A was designed to prevent further movement of migration towards surface water, and recover more mass of contaminants located in an area of the plume found to have a greater accumulation of VOCs.
- **Monitoring**—The goals of the plan are as follows:
 - Provide a tiered approach to attain the requirements of MEDEP water quality standards
 - Monitor changes in the plume boundaries and potential migration pathways
 - Monitor changes in ground-water contamination

- Monitor the effectiveness of the remedial action for the protection of human health and the environment
- Monitor the treatment plant effluent.
- **Five-Year Reviews**—Since the remedy will result in hazardous substances (contaminants of concern listed in the Final 1998 ROD) remaining in place, five-year reviews will continue to be conducted. In addition, conditions at Sites 4, 11, and 13 will be evaluated to determine whether additional response actions may be necessary at those sites.

5.3 AREAS OF NON-COMPLIANCE

Any substantial aspect of the remedial action that fails to conform to remedial objectives would be considered an area of non-compliance. Based on the information evaluated as part of the Type 1a five-year review, all areas currently comply with the ROD remedial objectives.

Institutional Controls

The operable unit remains within the restricted area of the base and, as such, the institutional controls are effective. However, ground-water institutional controls are not documented in the ROD and need to be added to the ROD. In addition, institutional controls for restriction of use and contact with ground water need to be included in the next revision of Operating Instruction NASBINST 5090.1A, "Restriction on Excavation Activities." The next revision of NASBINST 5090.1A is scheduled for September 2000.

Further Migration of the Eastern Plume

In the latest revision of the Long-Term Monitoring Plan, sentinel wells were located outside the area of known contamination and are used to warn of plume migration. The 1998 Annual Report summarized that "Ground-water samples collected from shallow and deep sentinel wells did not detect VOCs above MEG or MCL" (EA 2000b).

Future Negative Impact to Surface Water Resulting from Discharge of Contaminated Ground Water

No Eastern Plume contaminants of concern have been detected in surface water with the exception of anomalies involved with Monitoring Event 13. Trichloroethene was reported in associated method blanks, trip blanks, and equipment rinsate blanks and are considered laboratory or sampling artifacts. Based on these results, VOCs from the Eastern Plume do not appear to be significantly impacting surface water, although the potential impact to surface water cannot be fully evaluated due to the presence of trichloroethene in the sample method blanks during Monitoring Event 13. Additional surface water sample results have confirmed that no surface water impacts are caused by Eastern Plume contaminants of concern.

Reduce the Potential Risk Associated with Ingestion of Contaminated Ground Water to Acceptable Levels

The majority of the Eastern Plume remains within the restricted area of NAS Brunswick and, as such, placement of potable water wells is restricted.

Restore the Aquifer

The Eastern Plume system removed approximately 536 lbs. of VOCs during an operational period of July 1996 through May 1999. Mass removal averages approximately 15 lbs. per month.

While the current system is in compliance with the ROD, improvements can be made in the optimization of the system. A separate "Remedial Action Operation Optimization Case Study" was accomplished to review the Eastern Plume (Radian 1999). The primary purpose of this case study was to evaluate and assess the ongoing remedial action objectives program at the Eastern Plume system at NAS Brunswick, and provide recommendations resulting in attainment of site remedial action objectives and closure for optimal life cycle costs. Specific elements that were evaluated for the Eastern Plume pump and treat system include:

- Overall site remediation strategy and approach.
- Best operation and management practices already in place.
- Extraction system network, including all wells, screen intervals, and piping.
- Performance of treatment system components, including control systems.
- Operation, maintenance, and control for the treatment units.
- Treatment system data collection, analysis, and reporting.
- Effluent discharge options.
- Appropriate exit strategy for site closeout, including recommendations for the use of alternative technologies, as appropriate.
- Total estimated cost avoidance/savings from optimized operations.

5.4 RECOMMENDATIONS

No further response actions are required to be protective of human health and the environment at this time. However, optimization of the treatment system should continue and the final Long-Term Monitoring Plan should be implemented. The following recommendations are prioritized as follows:

- Enhance mass removal of contaminants in the Eastern Plume. Mass removal would be improved by replacement of existing extraction wells EW-4 and EW-5 with wells that are screened solely in the lower sand unit “hotspots.” In order to ensure appropriate piping size and treatment system capacity, determine ground-water flow rates and mass removal from these new extraction wells prior to making any modifications to the aboveground treatment system (Radian 1999).
- Add ground-water institutional controls to the ROD and amend Operating Instruction NASBINST 5090.1A “Restriction on Excavation Activities,” to add a restriction on use and physical contact with contaminated ground water.
- Modify the aboveground treatment system to allow effluent discharge to surface water or to an infiltration gallery after confirming the most effective and efficient option based on a detailed technical review and lifecycle cost analysis (Radian 1999).
- Determine if the southern terminus sentinel wells are adequately placed, and initiate work to correct the situation if necessary.
- Begin a formal evaluation for Monitored Natural Attenuation for the Eastern Plume. In particular, determine whether natural wetland biodegradation and/or natural attenuation processes are occurring at acceptable rates in the aquifer zone. Also, verify that the plume is stable. Ground-water monitoring results indicate that the downgradient extent of the plume apparently has not changed since at least 1995; however, additional remedial actions may be warranted in the area of the southern terminus of the Eastern Plume prior to formal initiation of monitored natural attenuation.
- Pursue negotiations with the regulatory agencies to establish risk-based cleanup levels for the entire Eastern Plume and alternate concentration limits for any ground water discharging to Mere Brook. Ground water at the Eastern Plume is not a drinking water source, thus cleanup to MCLs or State of Maine standards is not necessary for the remedy to remain protective of human health. In particular, begin discussions with the regulatory agencies to establish definitive criteria for discontinuing active ongoing operation and maintenance activities.

Long-term operations and maintenance activities will continue and will be summarized in annual reports. Annual reports and monitoring event reports will continue to be submitted to the U.S. EPA and MEDEP. The Long-Term Monitoring Plan will be refined as needed.

5.5 STATEMENT OF PROTECTIVENESS

The purpose of the five-year review is to ensure that the selected remedy remains protective of human health and the environment and is functioning as designed. The ground-water extraction and treatment system and the ground-water monitoring program have been only partially successful as implemented; but given the current data, these remedies appear to be protective of human health and the environment with the existing institutional controls as exercised by the Navy (restricted access area surrounded by fencing). The addition of institutional controls in the

ROD to restrict ground-water use will better ensure the protection of the selected remedy in the future and formalize the controls implemented by NASBINST 5090.1A. Long-term operation and maintenance of the extraction and treatment system is ongoing in addition to the long-term monitoring program.

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